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ABSTRACT

This guide on technology gives parents and community members an understanding of how information technology is an essential part of children's education in Vermont's schools. The first section provides an overview of technology, including: using technology to collect, share, and analyze information in ways that were impossible ten years ago: changes in teaching styles and the ability to accommodate a greater range of learning styles; broadening learning opportunities; the importance of technology skills for employability and citizenship; and using technology to interest children in learning. Areas for parents and community members to examine in order to become involved are suggested in the second section, including questions about technology planning. standards, use of software to promote creativity and problem-solving, access to technology, and Internet policy. Also included are: a glossary; examples of the use of technology for a weather watch activity, redrafting and simulations, music composition, and history instruction; a chart showing the "how" and "why" of several examples of the use of technology; and a list of print and World Wide Web resources. (MES)

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Technology in the Classroom

Computers and Instruction in Vermont's Schools

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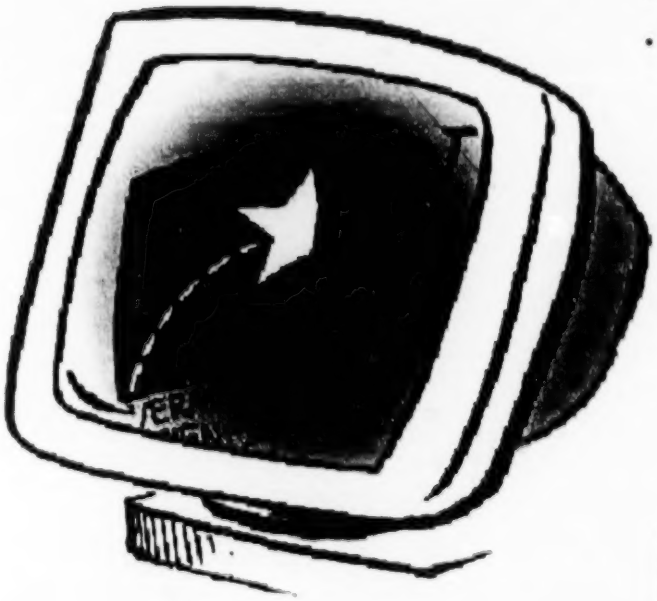

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The Vermont Institute for Science, Math and Technology (VISMT) was established in 1992 as a nonprofit organization to implement a $9.6-million National Science Foundation grant awarded to the Vermont Department of Education. A second 5-year grant was awarded in 1998. The goal of the project is to dramatically transform science, math and technology education for all Vermont students.

This booklet is one of a series funded through a grant from the Josephine Bay Paul and C. Michael Paul Foundation. VISMT and other education improvement organizations in Vermont are grateful to the Foundation for its thoughtful support of the programs that are improving the education of our children. Additional support provided by the Regional Alliance for Science Education

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"What's The Big Deal With Technology?"

Over the past seven years, Vermonters have worked together to set shared educational goals. The efforts of thousands of educators, business people, school board members, and community members resulted in a series of documents that culminated in *Vermont's Framework of Standards and Learning Opportunities*. The Framework is a guide to help school districts set standards for student performance and provide the opportunities all children need to learn.

The state's Equal Educational Opportunity Act, passed by the Legislature in June 1997, uses the Framework as a first step toward providing rich learning opportunities for all children in all Vermont towns. Equal access to resources is also assured — an important tool for schools needing to make investments in books, computers and professional training.

This guide on technology gives parents and community members an understanding of how new tools such as computers are an essential part of children's education.

It's important to realize that most of the material in this booklet is about **information technology** - anything to do with communication. But there is another world of technology out there also - everything that is man-made through math and science knowledge and skills, such as tools, products and machines.

Vermont is making great progress in creating excellence in education. Technology opportunities — opportunities that are available to all children to learn — are an important part of our efforts. This guide can assist you in understanding how technology is being used in your school's classrooms to help children.

GLOSSARY OF TERMS

E-mail — messages sent electronically over the Internet or through a network of computers wired together at a school or office.

Hardware — the electrical or mechanical components of a computer that allow it to operate and run programs.

Internet — the worldwide network of computers connected by telephone lines.

Network — computers joined together so users can send messages or exchange data files. A "server" computer is often used to store programs and files and to coordinate tasks such as printing or dialing out to the Internet.

On-line — connected to a network of computers, usually the Internet.

Software — electronic programs that enable a computer to do specific tasks, such as word-processing or creating spreadsheets.

URL — universal resource locator, or an address on the World Wide Web. Typically, it starts with "http" (hypertext transport protocol), followed by a colon and two backslashes, then "www" (World Wide Web), then the title of the site, and then a "domain" name such as "com" (commercial) or "org" (nonprofit organization). The result may be something like this: http://www.vsac.org, which is the Web address for the nonprofit Vermont Student Assistance Corp.

World Wide Web — the Internet "souped up" so that photos, drawings, and other graphics can be viewed on any computer connected to the "Web." The terms "Internet" and "World Wide Web" are now nearly synonymous.

Technology Overview

Some people are put off by technology while others are excited by it. Some feel it has little place in a classroom while others cannot imagine a classroom without it.

Actually, technology — the use of tools developed through scientific inquiry — has had a place in classrooms for decades. A telephone is technology, as are slide or movie projectors. If you took math or science classes 30 years ago, you may have used a slide rule — also technology.

This guide focuses mainly on what educators today call "information technology," which is defined as "tools that aid in communication, information gathering and processing, measurement and analysis, and improving productivity." That sounds like computers. But it's actually much more — telephones, fax machines, photocopiers, scanners, TVs, and video cameras.

There are other kinds of technology, too. Some people think of CAD technology, which is computer-assisted design, as a different field. For this guide, we'll look at all sorts of technology as it is used in classrooms.

Technology can sometimes seem omnipresent . This is different from previous "tech" tools. Slide rules didn't greatly change the dynamics of a classroom and of learning generally. Computers can.

Anyone who has visited a Vermont school recently has seen that computers are an important tool to support learning. As with many other tools and resources, how many computers a school has and how they are used can vary from community to community. However, with Vermont's Framework the state has now provided standards for how technology should be used, how it can help learning, and exactly what technology skills students need to learn.

That's why technology is woven through Vermont's Framework. As an example, an experiment in chemistry class about melting points used to require that substantial lab time be spent heating materials to collect needed data. Now, the experiment can be simulated on a computer in a fraction of the time, freeing valuable discussion time for analysis of the data.

The Framework notes the importance of providing technology tools "to engage students in active in-depth learning."

This guide will help you understand how technology is a critical part of Vermont children's learning.

"Why do any of this stuff? Is this just play or does it make sense?"

A student sits at a computer in the corner of a classroom. A map, an e-mail message, and a chart of numbers flash across the screen. Communicating with a friend who's moved to New Hampshire, telling him the engine size of her dad's new snowmobile?

Hardly. The sixth grader is exploring weather patterns. She is logging onto the Internet to look at on-line weather maps of northern New England. She checks her e-mail to see if students from other Vermont schools have sent weather data. She goes to a spreadsheet that she's created to enter the weather data from other schools, as well as from her own school's weather station next to the soccer field.

Technology in the classroom today is not a game or "add-on." Technology brings essential tools that students need to learn skills and gain knowledge. Students today — even those in primary grades — use technology to collect, share, and analyze information in ways that

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were impossible 10 years ago.

Studying weather is a good example of this. Students used to look at weather maps from newspapers, or take temperature readings outside the school door and record them on a sheet in their notebooks. Now, they can use technology to record the readings and plot changes using graphs. They can share data and gather more data on-line. They can communicate with other students living in completely different climate areas.

For children in rural schools, remoteness and lack of access to a well-stocked library are overcome. Technology helps equalize learning opportunities." Access to a variety of information-technology tools," as noted in Vermont's Framework, helps children "achieve the high standards" set out in the Framework.

Using technology in the classroom offers a vast array of opportunities for learning that today's adults never knew when they were in school. It also challenges the way teachers teach. Teachers are no longer the "sage on the stage," as one expression puts it, but partners with children in exploration and discovery.

"Technology allows me to do things in the classroom I've never been able to do before."

Even before computers became familiar sights in classrooms, teaching styles were changing. Children, recognized as individual learners, each has his or her own skills, interests, and energy. A teacher's job is to help the child perform at his or her highest level.

Teachers welcome the opportunities that technology brings to their classrooms. In addition to using the Internet, teachers use technology to help them accommodate a greater range of learning styles. Different students can be doing different things at different times. And students can do things no matter what their age, color, or gender. Barriers — real or imagined — are instantly erased.

Perhaps a teacher wants to help several students in her physics class who have become interested in trajectories. There is no need to drop everything just to work with those few students, or to step outside and throw balls in the air. Instead, students can plot trajectories on a computer and explore the interrelationship of angles and forces.

Across all subjects, technology opens up new possibilities. Art students can use computers for creating images — and easily start over if they don't like what they've done. Students in vocational-tech- nical programs can use computers for design work — and then test their designs to see if they work. Students in social studies classes can simulate environmental and economic problems, or research the origins of the Great Chicago Fire. Sources aren't limited to what's in the school library's card catalogue. A whole world of resources can be explored.

For disabled children, technology can help break down barriers. A blind student can use a computer to translate text into Braille. A quadriplegic can speak into a voice-recognition computer and have the spoken words translated into print.

Both teaching and learning have changed as a result of technology. New possibilities abound.

"Technology is a tool, not the focus."

We learn to drive a car not simply to learn how to drive a car. We learn so we can use a car to go places and do things.

If your school has been able to obtain computers for classroom use, you know that finding the funds to buy them and setting them up is only half the challenge. Certainly, children and teachers must learn how to turn the machines on, load programs, open files, and hook up to the Internet. But computers must be used to do things — like a car is used to go places.

WEATHER WATCH

It's January. Snow outside the school is deep, the temperature is at zero, stark tree branches are so frozen they crack with the slightest breeze. Dusk comes at 4 p.m. Imagine a student going on-line and tapping out a simple message, "What's the weather like outside your school today?" and receiving back the answer, "It was another hot day, temperatures in the 90s, even in the shade. But by the time our soccer match began after supper, it was a bit cooler."

In the short time it took for the messages to go back and forth, a student in Vermont has traveled halfway around the world to New Zealand — giving and getting "real" information that is fresh, full of detail, and revealing.

A teacher can use this information to engage the student in further exploration: Why is it warm in New Zealand in January? Why is it light into the evening? Why do trees there now have leaves while trees here in Vermont are bare and branches seem to be "cracking" in the cold? Why, in fact, do trees in Vermont in January seem to "crack?" Will limbs die and fall off before budding in the spring? Is it colder this January than last January?

These topics could have been explored with the tools yesterday's students used — pen-pal letter exchanges, weather maps in newspapers, almanacs, and encyclopedias. But technology adds another dimension to learning. It allows better, faster, and more accurate collecting, sharing, and analyzing of data. The data can be organized in different ways, prompting more questions and asking why something seems true.

Children are challenged to become curious learners, to go places where they've not been able to go before. Students can explore things individually, following interests in multiple directions that textbooks don't allow. Technology helps them gain mastery of topics identified in Vermont's Framework — in this case, "Identifying and recording the interrelated parts of Earth systems such as seasons, time, and weather."

http://www.weather.com/weather/us/cities/vt_lyndonville.htm

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For example, learning to use a computer for writing is useful. Using it to draft and re-draft an essay, however, is far more useful. Students can even e-mail drafts to students in other schools and ask for comments.

If your school has a satellite downlink, students can take courses from other schools, and share information, comments, and questions with other students who may be far away. Technology is a tool in a school's toolkit of resources, broadening learning opportunities for students.

"We need workers who can cross three or four disciplines....."

We live in a technological society. Students must develop advanced skills. For many, these skills will be critical to obtaining rewarding and good-paying jobs. Employability today very often depends on the technology skills one has gained.

There's more computer power in today's cars than in the Apollo spacecraft that landed on the moon. Today's car mechanics are technicians, not grease monkeys.

But just as technology is not just a focus but a tool, the worker who has gained technology skills knows how to use those skills to do other things — to "think outside the box," for example, to research and analyze multiple solutions to problems.

One educator has said that the single most important job for which schools must prepare all students is citizenship. Even in civics, technology opens new avenues of involvement. In many communities, local meetings

REDRAFTING AND SIMULATIONS

Remember the sinking feeling when your teacher told you to rewrite an essay? Doing all that handwriting or typing all over again was such a chore, let alone figuring out how to make the essay better. With computer word-processing, a student no longer faces that first chore of recopying what doesn't need revising. She can concentrate on what does need revising, and easily print out a new draft. "Redrafting" (sometimes up to a half dozen drafts) has become an accepted part of the writing process. The amount of writing and reading increases dramatically when students use information technology.

If your school had a chemistry lab, count yourself fortunate. Even if your school did have a lab, experiments were probably limited because of supplies or safety issues. Today, students in any school can do simulated experiments using computer programs. Even dangerous experiments can be performed safely — whether the school has a lab or not.

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are broadcast over cable access stations. Town and state data are available on-line, making it possible to gain important information about schools and communities — data that can help identify conditions affecting students' performance.

Helping students become highly skilled thinkers, workers, and citizens is critical for a state such as Vermont. Our state's greatest resource is not oil or rich farmland, but its people, who historically have been recognized for their creativity and ingenuity. Highly skilled workers will allow Vermont to attract and retain "clean" industries that fit with the state's commitment to maintaining a high-quality lifestyle in a healthy environment.

"Technology has helped me to focus my energy."

A student who yawned in math classes but became fascinated by computer simulations of health care systems is now working as an analyst in state government. A vocational-technical student who seemed to have few interests became adept with computer-assisted design (CAD) systems and is now working as a design engineer for an alternative vehicles manufacturing company. A third grader who thought science was a bore joined a river monitoring project where she monitored the quality of a small stream behind her school, and sent data to a local college as part of a statewide data collection effort.

Many keys unlock a child's mind and provide the energy that drives curiosity and hard work. One size or shape doesn't fit all. Educators believe there are many different intelligences that offer different paths of strengths and opportunities for young learners. Technology offers a whole new assortment of keys to allow a child to grow and develop.

Technology allows learning — even learning about "dusty" history — to become multi-dimensional and multi-faceted. Learning no longer has to be "linear," meaning it is no longer confined to textbooks with set sequences of written or pictorial information. Children can take one or several paths in discovering and learning about a subject.

Teachers don't just have a lot of interesting tools in their toolkit; they in fact have multiple toolkits. And sometimes it's students themselves who pick up and open the toolkits. Children become their own explorers, and there's no end to what they can do and where they can go.

INNOVATIVE COMPOSITION

An arts project offers Vermont students the chance to write music collaboratively. A student uses a computer to compose a short piece, and then sends it electronically over the Internet to other students and perhaps a music professor for critique and possible revision. The piece comes back to the composer, who can then play and revise the composition further. More than 5,000 students from all around the state have become engaged in this project.

Never before has music been composed in such an innovative and engaging manner. However, although the process is impressive, it's the final product that students are proud of when they perform the piece at a school concert.

http://www.webproject.org/

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Making the Connections

Here are some examples of how technology is used in the classroom to help children explore subjects and learn new skills. The "Why" section shows how the activities tie to Vermont's Framework of Standards and Learning Opportunities.

What	How	Why
Exploring temperature differences between two places.	Collecting and analyzing weather data using a computer spreadsheet and database, and collecting data over the Internet.	Identifying and recording the interrelated parts of earth systems such as seasons, time, and weather. (Vt. Framework, Standard 7.15)
Writing an essay on the contributions of African-Americans to American literature.	Researching information on CD encyclopedias or on the World Wide Web. Word-processing on a computer.	Drafting, revising, editing, and critiquing written products so that final drafts are appropriate in terms of purpose, organization, details, and voice or tone. (Vt. Framework, Standard 1.5) Understanding the concept of prejudice, and its effects on various groups. (Vt. Framework, Standard 4.4)
Creating a song or instrumental piece.	Composing music on a computer, sending the musical score over the Internet to other students and a music professor for critique.	Translating an idea into musical notation or sound. (Vt. Framework, Standard 5.32)
Testing the strength of a Roman-era arched bridge.	Simulating loads and stress using a computer software program.	Investigate the impacts, foreseen and unforeseen, of new knowledge and inventions. (Vt. Framework, Standard 6.4.b) Evaluate and adjust an engineering design process. (Vt. Framework, Standard 7.19.bbb)

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"This stuff has really turned my kid on to learning."

A former teacher remembers him as "a nice kid with brown eyes." As a student, he was "a wanderer," never quite focused. His mother says he never "connected" with learning — until he got his fingers on a computer keyboard. Suddenly, fingers became connections to a world of exploration and discovery that somehow he had missed.

He focuses on specific issues he wants to learn about. He is able to help other students find information for topics they're exploring. And he works with younger children in learning how to use the World Wide Web.

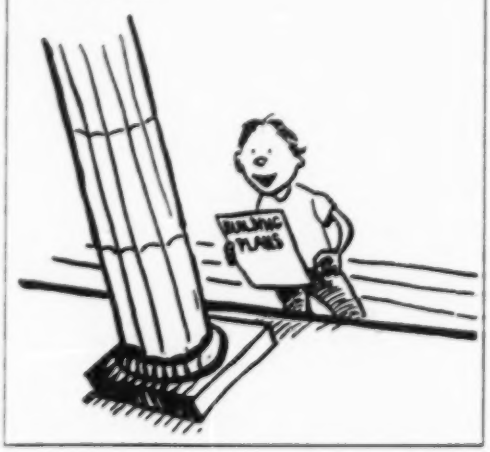
A school board member recalls the time students in a local school took on a problem connected with a town road. Local officials seemed stuck in reaching a decision about what to do. The students identified the exact nature of the problem, determined what they needed to learn about the situation to find solutions, gathered data by conducting tests and traffic counts, and presented their findings to the town selectboard. The students included a list of recommended options for the selectboard to review. Ultimately, the select board acted on one of the recommendations. The students basked in a local limelight of appreciation.

Land use issues bedeviled a local ski area. A student who enjoyed skiing wanted to understand more about the environmental impact of her sport. She gathered data by telephone, fax, and the World Wide Web, and built a database. Using the information in the database, she could show connections between a ski area's snow-making capability and its profit margin, between skier visits and decisions on building and installing new lifts, between its size and the number of second homes in local communities. Several assumptions she had about ski areas were changed after she studied her data. She presented her findings to the governor, whose administration at that point was dealing with numerous recreation industry-related issues. She felt she had made a real contribution to broader understanding of complicated issues.

At the core of all three examples are children and young adults who were turned on to learning. Technology was one of the tools they relied on to make their discoveries and feel valued as individuals with something worthwhile to contribute to their communities or state.

'Real' History

Think back on the time in Grade 5 or Grade 7 when you studied Roman history. It may have seemed distant and dry, prompting questions such as, "Why do we have to study this stuff, anyway?" Today, children can become engaged in that same history through sophisticated computer programs that allow them to build a Roman city, test the strength of a 2,000-year-old bridge, or explore how the Pantheon's dome in Rome still stands. On-line research can show effects of recent natural events, such as earthquakes.



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You Can Get Involved

Education research shows that students learn more when parents and other community members support children's education and are involved in their local school. There are things you and your neighbors can do to help teachers, principals, other school staff, and school board members use technology to help children learn. You can start by finding answers to some important questions:

• Has your school adopted a technology plan?

Every school should develop a plan that shows how technology will be used in the classroom to improve children's learning opportunities. The development of the plan should involve teachers, parents, board members, community members, and school administrators. It should be reviewed and updated yearly. A technology plan is also a requirement for receiving many grants and benefits, such as the lower "e-rate" for connections to the Internet and purchase of other technology tools.

• How can you tell if technology is working for your school?

Your school's technology plan should include "benchmarks" of success. These statements will tell what must be happening to achieve the plan's goals. A technology committee should oversee implementation of the plan, and school staff should report frequently to the committee on progress towards achieving the goals. Vermont's Framework of Standards and Learning Opportunities contains five standards around information technology topics: research, informational sources, communication of data, selection of appropriate technologies (Grades 5-12), and simulation and modeling (Grades 9-12). Technology is working for your school when you can see evidence the standards are being met.

• Does the software your school is using foster creativity and encourage problem-solving?

Good software does more than what traditional workbooks do. Instead of what are sometimes called "drill-and-kill" exercises, good computer software leads a child into explorations based on his or her interests and level of skill in specific areas. A good math program, for example, will help a child build addition skills by creating situations where solving a problem (finding the shortest way to the store) involves adding numbers. Finding the shortest route may include creating animated signs or composing a short musical tune as a password for a shortcut.

• Do all students in your school have equal access to technology tools?

An important goal of any technology plan is that all children have equal access to technology learning opportunities. Unequal access may result from gender differences. Boys are often seen as more "computer-oriented," but that stereotype must be overcome so girls are encouraged to use technology as frequently and easily as boys. Unequal access may also result from family background. A child whose family has no computer at home grows up with a significant disadvantage in learning technology skills. A good technology plan will take unequal circumstances into account.

• What's your school's Internet policy?

Every school should have an Internet, or "acceptable use," policy that sets requirements for use of technology at school. Much as a library will have a policy for the acquisition and use of books, a school must have a policy for accessing information on the Internet and World Wide Web. Electronic transmission of inappropriate material cannot be stopped by closing the school's doors and checking backpacks. Instead, rules must be adopted that specify how computers will be used to gather information from the Internet, or to share information within a school.

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To Learn More ...

Parent and community involvement is important to us all. If you have questions on technology issues, or your child's education, please ask for additional documents and further explanations.

- To get a copy of Vermont's Framework of Standards and Learning Opportunities, call the Vermont Department of Education (802/828-3111) or visit the World Wide Web (http://www.state.vt.us/educ/stand/page3.htm)
- To get a copy of the state's technology plan, call the Vermont Department of Education (802/828-3111) or visit the "techpage" on the World Wide Web (http://www.state.vt.us/educ/techpage.htm).
- If you'd like more information on science, math, and technology education in Vermont, call VISMT (802/244-8768) or visit us on the World Wide Web (http://vismt.uvm.edu).

Here are just a few interesting Web sites you might want to visit with your children, either at home or in school:

- **computers and software:** http://www.washingtonpost.com (Washington Post) and go to the section "Technology Post"
- **fun:** http://www.unitedmedia.com/ (comic strips and editorial cartoons)
- **homework and exploration:** http://www.pbs.org (public television)
- **museum:** http://www.si.edu/ (Smithsonian Institution)
- **newspaper:** http://www.washingtonpost.com (Washington Post)
- **parenting:** http://family.com/ (Family World) or http://www.families.com (Family Education Network)
- **search engine** (an electronic reference desk): http://www.yahoo.com (Yahoo)
- **sports:** http://pathfinder.com/SIFK/ (Sports Illustrated for Kids)
- **travel:** http://www.traveler.net (Travel Weekly)

Take every opportunity to talk with your child's teacher, and to meet with your school principal and other staff to learn more about technology issues and how you can help your child learn. Talk to school board members, and attend board meetings.

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What's New at VISMT

The Vermont Institute for Science, Math, and Technology (VISMT) was established in 1992 as a non-profit corporation to help to implement the $20 million National Science Foundation grant awarded to the Vermont Department of Education for a second Systemic grant. It was awarded in 1995. The goal of the project is to dramatically transform science, math, and technology education for all Vermont students.

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VISMT

VERMONT INSTITUTE FOR SCIENCE, MATH, & TECHNOLOGY

★ About VISMT

VISMT works with Vermont's schools and communities to transform science, mathematics, and technology education in order to improve the learning and the skills of all students. VISMT supports change in a systemic way by working with all constituents who have a stake in education. VISMT is funded through the National Science Foundation and is governed by a Board of Directors and has a skilled Professional Staff and a strong cadre of Teacher Associates.

★ Working With Vermont Schools

VISMT delivers its services to schools primarily through Professional Development services, which is most often conducted by an outstanding group of teachers "on loan" from their home school districts. Along with VISMT Professional Staff, they provide a wide range of support for teachers, administrators, parents, and other involved community members as part of a school's plan for systemic reform.

★ Program Areas

VISMT provides support in all of the key areas cited as critical for school reform. Vermont schools, work in partnership with VISMT, taking advantage of a wide range of support services connected to assessment, community and business partnerships, curriculum, equity, information technology, professional development, and school leadership.

★ VISMT Publications and Reports

In addition to regular newsletters, VISMT publishes a variety of documents helpful to schools and communities interested in improving science and mathematics education. Publications related to all program areas are available for free download.

★ Frequently Asked Questions

You may have questions about VISMT's role in supporting Vermont's educational transition to high-quality science and mathematics education. Frequently asked questions and their answers will give you a quick idea of VISMT's services and whether they are applicable to you and your school.

★ VISMT Web Site Map

This site is designed to have numerous links among the services VISMT provides. Using the site map a visitor can get a structural sense of the site in order to help find the appropriate information.

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